REMARKS

The Office Action of May 12, 2009, has been carefully reviewed, and in view of the above amendments and the following remarks, reconsideration and allowance of the pending claims are respectfully requested.

In the above Office Action, claim 1 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Freakes et al. (WO 2002/31461) in view of Bagdassarian et al. (U.S. Patent No. 4,393,321), Reuter (U.S. Patent No. 4,974,679) and Kusakabe et al. (EP 0710827) and view of Cullen et al. (U.S. Patent No. 4,422,055).

Independent claim 1, the only independent claim, has been amended as set forth above to more clearly define the claimed invention. Claim 1 is directed to a force or pressure sensor comprising, *inter alia*, a substantially rigid, mechanical-load resistant frame, a flexible diaphragm having an upper and a lower surface, said flexible diaphragm being secured to the frame, and a piezoelectric ceramic sensor diaphragm applied to the lower surface of the flexible diaphragm. A substantially rigid cover for loading the sensor diaphragm includes a protrusion or shoulder bearing against a middle section of the upper surface of the flexible diaphragm and thus, by deflection, prestresses the flexible diaphragm and the piezoelectric ceramic sensor diaphragm attached therebelow. The flexible diaphragm has a peripheral rim extending between mating edges of the frame and the cover such that the peripheral rim is fixedly secured therebetween.

The primary reference relied upon by the Examiner, Freakes et al. is directed to a pressure monitor 1 comprising a base 2 having a rigid frame 3A and a rigid base 3B defining a container 4. The container 4 has a lid 5 acting as a diaphragm so as to

define chamber 6 when the lid is secured to the container 4. Mounted within the chamber 6 is a substrate 7 which has formed thereon three SAW devices X, Y, Z.

Applicant respectfully submits that Freakes et al. does not disclose or suggest a flexible diaphragm which has a peripheral rim extending between mating edges of the frame and the cover such that the peripheral rim is fixedly secured therebetween, as recited in amended claim 1.

The substrate 7 which the Examiner contends allegedly corresponds to the claimed flexible diaphragm does not extend between the frame and the cover, as clearly shown in FIG. 1B. Moreover, the substrate 7 must have freely movable ends, not secured ends as in the claimed invention, in order to function. As explained in the second last paragraph of page 5 of Freakes et al, as pointed out in Applicant's previous response, even when the substrate 7 is adhesively secured to the base 2, the flexibility of the adhesive should be such that the respective end regions 8, 9 of the substrate 7 are free to move as substrate 7 is acted upon by a projection 10. The SAW principle used by Freakes et al. necessitates this kind of free movement, because otherwise the device would be unusable. This has been also explained by Cullen et al., teaching a cut in the surface of the piezoelectric SAW substrate for isolating a surface region where active SAW signal propagation occurs. The cut prevents any external stresses and undesirable surface strains from affecting SAW signal propagation in the isolated region (abstract and from column 1, line 35 to column 2, line 44 of Cullen et al.). Accordingly, Applicant submits that this limitation of claim 1 is not met by Freakes et al., or the other cited references.

Still further, Freakes et al. does not show "a piezoelectric ceramic sensor diaphragm applied to the lower surface of the flexible diaphragm," as recited in

amended claim 1. The Examiner refers to SAW device Y as a piezoelectric sensor diaphragm, however, Applicant respectfully disagrees with this interpretation. Applicant contends that substrate 7 is the element of piezoceramic material in Freakes et al. and that substrate 7 is not applied to the surface of any flexible diaphragm. On line 3 of page 1 of Freakes et al., there is a reference to GB-A-2352814, which corresponds to US 2002/0117005 Al and is identified on the accompanying Information Disclosure Statement. This reference discloses that SAW devices are mounted on piezoelectric substrates similar to the SAW devices of Freakes et al. being mounted on the substrate 7. In Freakes et al. (as in all SAW transducers) the SAW devices of non-piezoceramic material (sets of electrodes) are mounted on the substrate of piezoceramic material. None of the cited SAW patents designate the SAW substrate as a "flexible diaphragm", because the substrate, on which the SAW must be able to propagate and on which the SAW devices are mounted, can not be called a flexible diaphragm but only as diaphragm. The substrate must be rigid enough to be self supporting (not flexible) and of very hard piezoelectric material.

Moreover, even under the Examiner interpretation, the SAW device Y is applied to the upper surface of substrate 7 -- not to the lower surface. Hence, Freakes et al. does not disclose or suggest a piezoelectric ceramic sensor diaphragm applied to the lower surface of a flexible diaphragm, as recited in amended claim 1.

Further, Applicant submits that Freakes et al. does not disclose a cover that by deflection, prestresses the flexible diaphragm and the piezoelectric ceramic sensor diaphragm attached therebelow, because there is no such diaphragm

combination and there is no prestressing but only pressing when loaded (any prestressing would adversely affect the SAW signal propagation as clearly taught by Cullen et al. (teaches preventing of any external stresses and undesirable strains onto the piezoelectric element)).

Applicant contends that it is not obvious to arrange a rigid cover to prestress a combination of two diaphragms wherein a piezoelectric ceramic sensor diaphragm is applied to the surface of a flexible diaphragm having its peripheral rim fixedly secured to the frame. The resulting function of these features is unexpected based on the cited prior art, as the claimed sensor is, to Applicant's knowledge, the first sensor which enables measuring of force or pressure by producing the output signal directly by pressing the piezo material with the force to be measured which is only a fraction of the load ability of the sensor.

The secondary references cited and relied upon by the Examiner do not provide the teaching found to be lacking in Freakes et al. as discussed above. Accordingly, Applicant respectfully submits that claim 1 is patentable over the cited references.

Although claim 1 as amended above is believed to structurally distinguish over the applied art for at least the reasons set forth above, Applicant would nevertheless like to clarify the fundamental differences between Freakes et al. and the claimed invention and to further explain the SAW principle of Freakes et al. and Cullen et al, which simply can not be used in the claimed invention to obtain the desired high sensitivity under heavy static load.

The pressure sensor of Freakes et al and Cullen et al and in general, the pressure and force sensors using the SAW principle, function in the following manner.

A substrate of piezoelectric material is bended to change the phase of the surface acoustic wave propagating on the surface of the substrate. There are SAW resonator devices (sets of electrodes) attached onto the surface of the substrate to induce onto and to receive from the surface of the substrate the high frequency surface acoustic wave (SAW). By bending the substrate, the propagating SAW is caused to change its phase, and this change of phase is a direct measure of the pressure or force bending the substrate. Freakes et al uses this change of phase (or change of wave length) for measuring the change in the resonant frequency of the SAW devices.

Contrary to this function of the SAW-devices, the present invention produces the measuring signal directly from the movement of the diaphragm which is caused directly by the force to be measured, without need of any excitation signal as in the SAW devices.

In Freakes et al., the lid is disclosed as "at least part of the lid being flexible and forming a diaphragm which will deflect in response to changes in the fluid pressure surrounding the monitor," (Page 1, lines 10 and 11). Taking into account the measuring principle, the more the lid resists deflection in response to the pressure changes, the more it reduces the dynamic measuring sensitivity. There is no reason, and hence no motivation, to replace the flexible lid with a substantially rigid cover, because it would reduce the measuring sensitivity and in the field of measuring tire pressure, the load of 50 kg would make the sensor unusable.

A detailed discussion of the additional distinguishing aspects of the remaining dependent claims is not set forth at this time as the dependent claims are allowable by virtue of their dependence from allowable independent claim 1.

CONCLUSION

In view of the above amendments and remarks, Applicant respectfully submits that the claims of the present application are now in condition for allowance, and an early indication of the same is earnestly solicited.

Should any questions arise in connection with this application or should the Examiner believe that a telephone conference would be helpful in resolving any remaining issues pertaining to this application; the Examiner is kindly invited to call the undersigned counsel for Applicant regarding the same.

Respectfully submitted,

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